

A Discussion Paper on the Convergence of Augmentative and Alternative Communication (A.A.C.) Devices & Portable Computers



**Rebecca Gallio
Rehabilitation Engineer
Research & Development
Regency Park Rehabilitation Engineering**

**Ben Symonds
Rehabilitation Engineer
Research & Development
Regency Park Rehabilitation Engineering**

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Introduction

As computers become smaller, more powerful, more compact and portable, with longer battery life, the desire to explore their use as a communication device with appropriate software has become an area of interest. Computers are becoming integrated into everyday life at school, work and in the home. They can be used for multiple tasks, such as communication via email and Internet, word processing, an in depth source of information and other forms of problem solving. It is perceived that the use of a laptop as a communication device will provide greater independence to the user and provide the user with other options in different environments without changing devices. It is also perceived that the cost of setting up a custom system using a laptop and A.A.C. software is cheaper than buying a communication device. This report will compare 'off-the-shelf' and customised systems in order to see if this perception is true.

Another aim of this report will be to investigate the benefits associated with using portable computers (laptops) as communication devices. Some of the current 'off-the shelf' laptop based communication systems available on the market will be presented and some associated advantages and disadvantages for each of these systems will be discussed.

There are three clients within C.C.A. (both child and adult services) who utilise a laptop based communication system and have been using these relatively successfully. However, these systems have experienced some problems and the related complications will be briefly discussed.

To clarify the terminology used in the report, the following definitions are necessary:

- **'Off-the-shelf'** systems refer to integrated, speech-generating devices that can be purchased fully packaged with communication software, switch and joystick interfaces, amplified audio, etc built into the one complete unit. They are devices based on laptop technology and built on Windows or Mac operating systems, thus providing access to standard P.C. (personal computer) software such as word processing, Internet and email. An example 'off-the-shelf' system is the Mercury.
- **Custom** systems refer to the use of a standard laptop (or tablet style) computer and Windows or MAC operating system to set up a customised integrated system. Features such as communication, environmental control and switch/joystick access are enabled by connecting additional hardware and installing relevant software. Thus this is a solution with the potential to achieve the same ultimate functionality as an 'off-the-shelf' system, but can be customised to address specific needs.
- **Laptop** – this term is used to describe a non-desktop or 'portable' computer.

Portable Computers with A.A.C. Software – Perceived Benefits

There are many perceived benefits that have been outlined for the use of a portable computer as an A.A.C. device. The main advantage is ready availability of many computer functions without having to change devices (ie: multiple uses for a single system), however there are many other perceived advantages including:

- Integration of systems to easily move from communication software to other software. In situations like the classroom this would be of great benefit, since the user's one piece of equipment can have multiple uses. For a student who can't write it may be beneficial to have a laptop to carry out word processing tasks in the classroom. Use of a laptop that incorporates both A.A.C. and word processing functions would remove the need to swap between separate devices.
- Computers are perceived as more 'normal' or mainstream as opposed to dedicated devices. Teachers and parents may be more willing to assist in the use of the A.A.C. device if an integrated system is used as they are likely to find them less 'intimidating' than dedicated communication devices.
- An integrated system, which is reliable, durable and easily mounted, would save time, money, and effort. More and more children are included in regular schools and staff and peers intuitively understand computers better. This creates the potential to increase the use of A.A.C. with a laptop and decrease the required support and training.
- Change over software as user's needs change $\Rightarrow$ more scope for change.
- Computer games for users, which could develop a user's functional and cognitive ability/skills.
- Cost benefit $\Rightarrow$ laptops are perceived to be cheaper than a dedicated A.A.C. device, or 'off the shelf' system.

Current 'Off-the-Shelf' Laptop Based Communication Systems

As the interest in using laptops for communication has increased various companies have started to produce communication systems. A few of these are listed below with a brief summary of their key features. Detailed specification sheets, including prices, for these devices are included in Appendix A.

Gemini



The Gemini is an A.A.C. device and Macintosh® tablet style computer. This device will run communication software, educational software and allows Internet access. It supports a variety of access methods, making it adaptable to a variety of user needs. The standard package is pre-installed with Speaking Dynamically and Boardmaker from Mayer Johnson. Other pre-installed software includes Microsoft Internet Explorer, Microsoft Outlook Express, Netscape Communicator, Adobe Acrobat Reader, QuickTime, AppleWorks, and America Online.

Mercury



The Mercury is a “ruggedised” Windows XP tablet style computer that has been designed for use as a communication device. It has a built in touch screen, jacks for connecting access devices such as switches and joysticks and improved speakers for communicating in noisy environments. It can be loaded with windows compatible communication software and provides Internet access. A universal remote control has been built in to give the user environmental control capabilities. The built in desk stand and mounting plate are compatible with C.J.T. Enterprises (C.J.T.) and Daedalus Technologies (DaeSSy) mounting systems.

Optimist II



The Optimist II is an A.A.C. aid based on a hand-held tablet-size, personal pen computer loaded with a Windows 98 operating system. It incorporates a touch screen for direct selection and also provides switch and joystick access. An audio amplifier module increases the volume and clarity of output to assist speech in noisy environments. It can be purchased with a variety of speech synthesis and A.A.C. packages depending on the user's specific needs.

Freedom 2000 Extreme toughbook



The 2000 Extreme Toughbook is a computer-based communication system that has been built using the 'ruggedised' *Panasonic Toughbook* as a platform. Ruggedised features include a removable hard drive mounted in shock-absorbing gel and encased in stainless steel. It is water and dust resistant and is protected by a tough magnesium case. It comes pre-loaded with either E.Z. Keys or Talking Screen.

Freedom 2000 toughbook



The Freedom 2000 Toughbook is again built using one of the ruggedised *Panasonic Toughbooks* as a platform, but is not quite as rugged as the Extreme Toughbook. It has a magnesium-alloy protected L.C.D. display and shock-mounted components. It comes pre-loaded with either E.Z. Keys or Talking Screen.

Current 'Off-the-Shelf' P.D.A. Based Communication Systems

There are also some communications systems on the market that use the window C.E. environment allowing for a compact system that looks exactly like a personal digital assistant (P.D.A.), but can be used for communication. These platforms are smaller and lighter than laptop based systems, providing longer battery life. Two examples are given below:

Polyana



Polyana is an A.A.C. aid based on a modified Windows C.E. device. The Polyana also incorporates an audio amplifier to enhance the volume and clarity of voice output.

Chat P.C. 2



Chat P.C. is built on the iPAQ palm-top computer with a specially designed protective rubber cover and an additional audio amplifier. The device has DecTalk speech output, recorded speech capabilities and comes with over 3000 Mayer Johnson P.C.S. symbols. Users can also be given access to Pocket versions of Microsoft Word, Excel and an M.P.3. player.

Custom Systems Used by C.C.A. Clients

Within the organisation, speech pathologists and occupational therapists have worked together to produce some custom laptop systems for C.C.A. clients, which are successfully being used for communication and schoolwork. The following cases briefly describe these systems and some of the problems that have been encountered.

Case 1

Client background:

- 7 years old in a mainstream classroom.
- Athetoid Cerebral Palsy.
- Quadriplegia.
- Speech can be intelligible in context.
- Vision and hearing unaffected.

HARDWARE	COMMENTS
IBM platform (DELL Inspiron Computer).	Chosen for compatibility with school system.
Custom Designed mounting cradle and arm.	To place laptop in view.
Discover switch.	Discover Switch was too bulky and needed to be placed in a more compact box.
External speakers to improve volume.	External speakers needed to be placed on the chair, as the built in speakers on the laptop could not be heard over the noise in the classroom.

SOFTWARE	COMMENTS
Discover Switch for P.C.	Ability to custom make scanning arrays. Mouse emulation features more efficient than other available software. Client had 3yrs prior experience with this.
Write:outloud v.3.	Tool to assist with literacy skill development . Simplified toolbar to facilitate independence with printing/saving/etc. Word processor with synthesised voice output and a range of voices. Availability of file storage gives access to pre-made stories.
Co:writer	Provision of word (and next word) prediction software, abbreviation expansion and ability to learn the users vocabulary. These features allow rate enhancement & savings in switch hits required. Literacy support for spelling difficulty. Talk mode allows toggling between word processing and voice output. Provides a range of source dictionaries.

Problems:

- The process of setting up a customised mounting cradle was a complex, timely process and the mounting caused problems with wheelchair stability.
- Speakers were difficult to mount due to bulk, but were attached with Velcro to the side of the chair.

Case 2

No client background.

This laptop system provides a means of communication and is also used for schoolwork eg: written work. The computer is on for most of the day allowing for both response and initiation of conversation. The wheelchair joystick is used to access the computer, using a customised system. Using a switch the joystick can be toggled between computer and driving mode. The computer screen needs to be lowered by an attendant to allow visibility when driving. This means the lid is left slightly ajar to be able to see clearly when driving but also to “speak” readily if required.

HARDWARE	COMMENTS
Toshiba Satellite Pro 480CDT IBM laptop with external Floppy drive.	
Customised wheelchair joystick to operate mouse.	Able to toggle between driving and computer mode with a single switch.
Trackball Mouse	Used when joystick is not functioning properly as there are sometimes problems with the custom system.
Mounting system.	

SOFTWARE	COMMENTS
Clicker 3.	Provides an on screen keyboard.
Dynavox .	

Problems:

- Not enough memory for software needs.
- Computer has frequent breakdowns and screen freezes due to:
 - Joystick mouse.
 - Cable connections.
 - Memory overloads.
- Dynavox sound must be manually switched on every time it is used.
- External floppy works inconsistently.
- Battery life not long enough.
- An attendant is required to plug in the cable.

Due to the problems that were experienced, after three years of use a new laptop integrated system is being produced. This system consists of some features from the old system, some upgrades and some replacements. The new system incorporates:

HARDWARE	COMMENTS
IBM platform (DELL Latitude Computer).	
Customised wheelchair joystick to operate mouse.	Able to toggle between driving and computer mode with a single switch. This system is being carried over from the past communication system. Need to adapt the joystick to include right mouse button.
Mounting system.	Must be adapted to fit with new hardware.

SOFTWARE	COMMENTS
Clicker 4.	Provides an on screen keyboard. Allow use of any word processing program. Upgrade to Clicker 3 used in previous system. Familiarity with program.
Speaking Dynamically Pro.	Combines writing and communication software in the one program. Has communication features not available in Dynavox. No known clashes with other systems. Eliminate software/soundcard clashes with clicker software. Allow the use of one software program.

Case 3

(Price & Noble)

Client background:

- 36 year old male.
- Athetoid Cerebral Palsy.
- No speech.
- Some communication using facial expressions and gestures.

HARDWARE	COMMENTS
IBM platform (Viewmaster Pentium 75 Laptop).	
Keyguard.	Help with accuracy in key selection.
Mounting system.	Enables the laptop to be moved from side to side as required.
Interface for use of wheelchair battery.	The laptop must be charged with a mains supply once a month to preserve the battery.
Mouse Keys box.	Mouse access.

SOFTWARE	COMMENTS
E.Z.Keys for windows.	Chosen after consideration of physical access needs and personal preferences. Rate enhancement features. “Side Talk” feature used for communication.
DECtalk Express speech synthesiser.	

Problems:

- Mounting system needed to be redesigned to allow for better visibility when driving and foam padding was added between the tray and the computer to decrease the effect of vibrations.
- The computer is run off of the wheelchair battery and connected via a cable. This wiring connection is vulnerable to damage and needs regular maintenance.
- The durability of the system has caused a problem; the cables are vulnerable to damage but can be easily replaced. However, interference was reported on the screen after about a year and needed to be replaced. Due to the high cost of this replacement a new laptop was purchased instead.

Problems Associated With Custom Systems

Discussions with therapists who have had experience setting up custom integrated systems revealed several key issues that should be considered when considering laptops for A.A.C. The following table gives a summary of these issues and offers some potential solutions for each. These and other issues are discussed in greater detail on the subsequent pages:

Identified key points to explore and address when considering laptops for A.A.C.	Potential solutions used in existing integrated systems
Durability of laptop computers – standard laptops can be prone to hard-drive, screen and port damage.	In other systems durability is addressed using ruggedised computers, including the Panasonic Toughbook, which will take more disruption than an ordinary laptop. Pen-Tablet computers are also an option as they are light, portable and durable. They also have touch screens to allow easy access to the communication software. Fujitsu sell plastic screen protectors for their tablets and soft cases that allow use of the device whilst in the cover.
Computer mounting, in particular reducing and avoiding problems caused by on-going vibrations, stability of chair after adding the mounting system.	The problem of vibrations with mounting seems to be remedied using a piece of foam (or other shock absorbing materials) between the laptop and the tray, stopping any damage caused by the vibrations of the power-chair.
Volume and voice quality eg. In classrooms or pubs where there is background noise.	Adding battery powered speakers to increase volume and improve sound quality. Companies like Gewa manufacture mini amplifiers that can be attached to increase volume.
Wearing and breakdown of cables and port damage due to cables being connected and reconnected.	A customised heavy duty lock in/easy release electronic connector maybe a potential solution if it is necessary to remove the tray and/or laptop regularly, this connector is easy to both lock and release.
Battery life for laptops.	Laptops can be powered from the wheelchair battery requiring connection from the wheelchair to the laptop allowing the computer to run longer than its battery can.
Visibility; when driving, when outdoors in direct sunlight.	Tablet PCs, such as the Fujitsu, provide the option for an outdoor viewable reflective L.C.D. screen. Fold-away mounts that allow a device to be swivelled out of the way are available and accommodate most A.A.C. devices, laptops and tablets, but are very expensive.
Access method.	Switch adapted mouse or keyboards can allow a switch user some access to standard laptop programs.
Access to laptop programs.	Some of the tablets offer programmable application launch buttons.

Laptop/ Tablet Computer Considerations

With the advancement of technology and the increased durability of commercial and personal laptops, the use of computers for communication devices becomes an attractive possibility. With the development of many different brands of tablet computers this customised option becomes even more attractive providing increased portability getting close to that of a dedicated communication device. However there are many points to consider if attempting to replicate the functionality of the 'off-the-shelf' A.A.C. systems. A few of these considerations are listed below, however it is strongly recommended that the document "*Things to Consider when choosing a laptop for A.A.C.*" (Appendix D - written by Sandra Stewart & Sue VanDeLoo) be read to gain a comprehensive understanding of the required considerations. This document is slightly dated but nevertheless provides some very useful information.

How will the user access their device?

If switch access is required then an additional switch interface (and possibly the necessary software) must be purchased. Switch adapted mice or keyboards can also allow a switch user some access to standard laptop programs. These options will result in extra hardware that needs to be mounted and therefore additional cables. Thus you will have to consider mounting of the switch interface as well as the computer and switches. For Words Plus software the Micro CommPac is a device that provides a switch/joystick interface plus an external amplifier for improved voice output. If using Sensory Software programs then you might consider Gewa's Mini Amplifier with Switch Interface. This product can also be purchased with an in-built Gewa Prog module for P.C. based environmental control.

Many of the current tablets and some laptops provide programmable application launch buttons, which may enable easier access to some of the standard windows applications, without having to locate and select icons.

If the person is a keyboard user then it is not necessary to have a touchscreen (this could save significantly on cost) – however, if it is foreseeable that a touchscreen might be required in the future then it could be wise to purchase a tablet (i.e. Fujitsu Stylistic) or a touchscreen laptop (i.e. Toughbook) to keep your options open.

Keyboard users are not ruled out from tablets as they generally allow connection of a keyboard, but again this may introduce an extra cable. Bear in mind that keyboard and mouse additions may decrease the portability of the system as well as the available room on a wheelchair tray top. Tablets, such as the Compaq, have a removable keyboard that provides the ability to change from tablet mode to notebook P.C. mode with relative ease. The Toshiba and Acer tablets can be converted from tablet to notebook mode by simply swivelling the screen (shown in Figure 1).



Figure 1: Toshiba Tablet P.C.

What software is required?

There are many communication software products on the market such as:

- Speaking Dynamically Pro
- E.Z. Keys talking screen
- Winspeak
- Win bag
- Clicker 4
- The Grid
- WiVox
- Write out loud
- Writing with symbols
- Discover
- Dynavox

The above programs often have access options built into the software allowing clients to use the program with switches or other access methods. These features are not always included within the windows environment in which case it is difficult to use the Internet, word processing and other windows software. In order to be able to obtain switch or alternative access to windows software on a computer it will be necessary to use further software, such as the Hands off program, E.Z. keys, Discover, or The Grid. This becomes an additional cost in setting up the system and requires additional training for the clients.

How durable does it need to be?

If the user is rough on their equipment then the 'ultimate' rugged computers are the Panasonic Toughbooks that are widely used for police and military applications. These computers have been tested to military standards and can withstand rain, coffee spills and heavy dust. The hard-drives are shock mounted so the laptop can withstand heavy vibration and drops of 3 feet (see the Toughbook website for further details and information <http://www.panasonic.com/computer/toughbook/home.asp>).

If you don't require military standard, but still require a slightly more rugged system then the Fujitsu Stylistic tablets may be acceptable. Pen Tablet Magazine (Walker, 2002) suggest that "Fujitsu, who have been in the pen tablet business for a long time, have learned through years of painful experience exactly where the weak points are in a tablet, so their products tend to be more durable than average" (not even close to the Toughbooks however). They utilise a magnesium case and shock mounted hard-drive to achieve an increased durability. The Fujitsu has been widely used as an A.A.C. device and

is the basis of some systems put together by Gus Communications, so it has quite a documented track record.



Figure 2: Panasonic Toughbook. (Picture from <http://www.panasonic.ca/English/Office/notebook/ruggedfeatures.asp> accessed 12/5/2004)

If durability is not a major consideration for a given client, then the purchase of a standard, non-durable laptop would offer quite a large cost saving. Care needs to be taken if this direction is followed – if you get it wrong and the laptop breaks down do to an issue like hard-drive damage then the user may be without the device for long periods. Worse still, if the device is particularly badly damaged, the whole process of purchasing and setting up a laptop system may have to be repeated.

What technical support is available?

If the system fails then it may severely impede the user's ability to carry out their day-to-day tasks. Thus, it is important to investigate the level of support available to minimise downtime. For example, both Dell and Compaq provide 24x7 telephone technical support within the warranty period, and lifetime or 'limitless' warranty's can be purchased.

What are the user's needs?

This includes present and future needs. For example, if the laptop is going to be used to control an E.C.U. (environmental control unit), such as the GEWA Prog III, then it must provide an R.S.232 serial port, which some of the tablet computers do not provide. Similarly, some switch boxes require a P.S.2 port, which is not necessarily provided on newer P.C.s Thus it is important to consider the devices that will/may be interfaced to the computer and ensure the chosen product can support all required hardware.

What is the sound like? Are additional amplifiers or speakers required?

Generally the standard speakers on a laptop/tablet computer will be inadequate for communicating in all but the quietest environments. Addition of speakers is a simple option, but will again contribute more cables, possibly take up tray top space, and

introduce further mounting complications. Another option is to use a device such as the Micro CommPac or Gewa Mini Amplifier. The GEWA amplifier (available through ZYGO) comes in three different models; (1) with only amplifier, (2) with both amplifier and possibility to connect switches and (3) including amplifier, connection for switches and a built in IR-transmitter for environmental control.



Figure 3: GEWA Mini Amplifier. (Picture from <http://www.gewa.se/svensk/laddahem/Manualer/809060.pdf>, accessed 12/5/2004)

If intending to use the standard laptop speakers it pays to listen to and compare brands, as there can be a substantial difference in the quality and volume of output. The Compaq laptops for example provide superior audio features (volume and quality) to many others and this may be adequate for some communication purposes.

How often do they use the device? How long must it be turned on? What power sources are available?

Most laptop computers have a battery life of only 2 to 4.5 hours but, as with sound, it pays to compare brands. For example, the Compaq Evo N620c notebook claims up to 6 hours of battery life (10 with an additional battery), which is double that of the Dell Performance Latitude C840, which only claims 2½ -3 hours. Bear in mind that this stated battery life is the maximum, and in reality will always be less.

Users who require extended use will need to use either a mains supply or, if available, a wheelchair battery. Use of the wheelchair battery will require a wheelchair power adaptor (this is integrated with the Mercury system) and the drawback is that it reduces the drive time of the wheelchair. If this is an issue then it may be necessary to add an additional power pack to supply the laptop. Most laptop manufacturers offer an optional automobile battery adaptor at an additional cost (Compaq is \$135), but be aware that this requires a 12-volt input, whereas wheelchair batteries will generally provide 24 volts. A custom laptop power supply, that converts a 24-volt wheelchair supply to the required laptop input voltage, can be purchased for around \$200, and this is probably the best option to pursue if powering directly from a wheelchair.

What issues arise concerning mounting?

Most 'off the shelf' A.A.C. devices have a mounting plate attached, however the need to buy compatible mounting systems can elevate the cost of mounting the device on a wheelchair. If the communication device is going to be tray mounted then it is often

possible to mount a laptop for significantly less than an 'off the shelf' A.A.C. device (approximately \$500 vs \$900). However, mounting the communication device on the flip up tray of a *manual* wheelchair will compromise stability and thus more complex assemblies, such as the Daessy mounts, may have to be employed. If this is the case, the cost of mounting a laptop/tablet may be significantly elevated above that of an 'off the shelf' device. Thus there are advantages and disadvantages for either option and ultimately the cost of mounting is going to vary depending on the type of wheelchair, the mounting position, the type of device, etc.

There are many variations in mounting needs that have not been discussed, as it can become a very complex issue. It will be necessary to assess specific mounting needs and then consult a mobility and seating specialist and an engineer to determine the mounting issues for each specific case. In short, mounting of both a custom laptop/tablet and an 'off the shelf' system will involve specialist input and neither can be considered more cost effective than the other (the cost can only be assessed on a case by case basis).

Who will implement the integrated system?

If intending to set up an integrated system with a laptop/tablet then it will require someone with the relevant technical expertise. This will be an added expense and may bring the ultimate cost of implementation in line with the 'off-the-shelf' products, depending on the complexity of the system. This factor may rule out a laptop solution for many cases, unless someone involved is willing or available to offer their technical expertise at little or no cost. Thus the issue of who will implement the system (and at what cost) must be clarified before making the decision to embark on such a project.

Custom Laptop Based Communication Systems

There are countless options available if intending to set up communication software on a laptop or tablet P.C. The following options are simply an illustration of potential systems, and their cost using 4 different laptop/tablet P.C.s; the Fujitsu Stylistic Tablet, Compaq Tablet, Panasonic Toughbook laptop and Dell Inspiron laptop (the stated prices are as advertised in April 2004). The final decision will of course be governed by the specific needs of a given user. In any of the examples given below, the laptop/tablet shown *could* be exchanged with another, as long as the chosen P.C. has adequate memory to run the software (check with the software distributor), and it provides the necessary ports for connection of peripherals, such as the E.C.U. and switch interface. For example, the Fujitsu Stylistic 3500 is the only *tablet* of those shown that provides a serial port, which is required for the Prog III. The choice of laptop/tablet may, of course, increase or decrease the total final cost, but the aim is to select the most suitable P.C. for the intended user (make sure you have read “*Things to consider when choosing a laptop for A.A.C.*”).

Three of the examples shown utilize touch-screen P.C.s, however if this is not a required feature then the cost *may* be lowered by purchasing a standard screen laptop. If E.C.U. is to be controlled with the P.C. alone then it is possible to purchase a Prog III without keypad function (reducing the cost by ~\$200).

The final point regarding this cost analysis is that the additional cost of actually setting up and implementing the given systems cannot be factored in. As mentioned previously, this cost will vary depending on the complexity of the system and the availability of a *willing* participant. The time of engineering, therapy and IT professionals can be a costly resource that may contribute significantly to the total cost of the system.

Example 1

Laptop/Tablet + Speaking Dynamically Pro + Switch Interface + E.C.U. + Speakers

Example:

- Speaking Dynamically Pro and Boardmaker (requires a mouse/keyboard switch interface) - \$1178.
- Clicker U.S.B. switch interface - \$299.
- Prog III (with keypad) and cable kit - \$1072.
- P.C. speakers - ~\$30.
- Wheelchair battery power converter (not shown) - \$200.

Laptop	Fujitsu Stylistic 3500 (\$6000).	Panasonic Toughbook 73 (\$5899).	Dell Inspiron 600M (\$2098).
Total cost	\$8779	\$8678	\$4877

*Fujitsu Stylistic 3500 shown below. (Picture from <http://www.infocater.com/stylistic3500.shtml> accessed on 12/5/2004)



Example 2

Laptop/Tablet + Speaking Dynamically Pro + Switch Interface

(If you don't need E.C.U. and your chosen P.C.'s built in speakers are adequate).

Example:

- Speaking Dynamically Pro and Boardmaker (requires a mouse/keyboard switch interface) - \$1178.
- Clicker U.S.B. switch interface - \$299.
- Wheelchair battery power converter (not shown) - \$200.

Laptop	Fujitsu Stylistic 3500 (\$6000).	Panasonic Toughbook 73 (\$5899).	Dell Inspiron 600M (\$2098).	Compaq Tablet P.C. (\$2575).
Total cost	\$7679	\$7578	\$3777	\$4252

*Compaq Tablet shown below. (Picture from www.tablet-central.com/compaq_pcs.htm, accessed on 12/5/2004)



Example 3

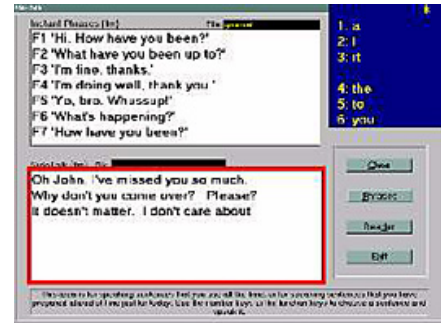
Laptop/Tablet + E.Z. keys + Micro CommPac + E.C.U.

Example:

- E.Z. keys with Micro CommPac and DECTalk - \$4770.
- Prog III(with keypad) and cable kit - \$1072.
- Wheelchair battery power converter (not shown) - \$200.

Laptop	Fujitsu Stylistic 3500 (\$6000)	Panasonic Toughbook 73 (\$5899)	Dell Inspiron 600M (\$2098)
Total cost	\$12042	\$11941	\$8140

*Panasonic Toughbook 73 shown below. (Picture from <http://www.smoothroad.com/products/toughbook/p73.asp> accessed 12/5/2004)



Conclusion

If we consider the combined cost of hardware and software, a custom laptop system may *appear* to be significantly less expensive than an 'off-the-shelf' device. A custom system also offers the cost advantage of not always including additional (and sometimes unnecessary) functions, such as E.C.U., which are integrated into the 'off-the-shelf' packages. However, these "extras" that 'off the shelf' solutions offer may be considered an advantage.

An advantage that 'off-the-shelf' systems have is that they come with pre-installed hardware and communication software, and therefore the customer receives a complete product that should work and interface seamlessly in the given configuration. With a custom laptop system there may be initial teething problems whilst getting the system up and running (this is not to say that an 'off-the-shelf' system won't have its share of problems). This raises the question as to who will actually get the system up and running. As already mentioned, the expense involved with getting a suitably qualified professional to implement the system could elevate the cost of a custom system to be on par with the 'off-the-shelf' systems. This also raises the issue of hardware/software support and who will provide such support. An 'off-the-shelf' device carries with it the warranties and support of the manufacturer, to some extent.

Care must be taken if you intend to purchase an 'off-the-shelf' system, as *some* of the products do not appear to offer any advantage over a custom made system. This appears to be the case for a few laptop systems more so than tablet systems, however this may change as tablets gain popularity in the mainstream market, thus reducing their cost. The Freedom Toughbooks are an example where an equivalent custom system could be put together, for a significant cost saving, without compromising any function. Of course this assumes that whoever puts the system together and installs the software is experienced and capable of setting up such a system.

If a fully integrated tablet style system including E.C.U., switch access, joystick access, etc is required then the Mercury (or similar) would be a wise choice. The 'off-the-shelf' device minimises the number of cables and connections by integrating hardware such as switch interfaces, wheelchair power adaptor and E.C.U. into the package, thus improving the long-term reliability of the overall system. If funding is available for the 'off-the-shelf' device then there seems no reason to attempt to replicate the system. However this document has shown that if cost is an issue then it may be possible to construct an equivalent, cost-effective system. Sacrificing features such as durability and touchscreens, if they are not deemed necessary, can reduce the overall cost of the system, but it would be advisable to exercise some caution in pursuing this alternative.

One big unknown is the cost of mounting either a laptop/tablet or commercial A.A.C. device and this could easily contribute anywhere from \$500 to over \$1000 to the total bill. If intending to set up a custom laptop or tablet based A.A.C. device the most important

point is to ensure that you have explored all the information available. Make sure you understand all the potential issues and problems and have discussed the idea with a suitably experienced professional. Investing time in the 'research' phase will ultimately save time and money in the end, by increasing the chances of a suitable system with favourable outcomes for the intended user.

References

Price, L. & Noble, G., "Using a Laptop Computer as a Communication device".

Stewart, S. & van de Loo, S., "Things to Consider when Choosing a Laptop for A.A.C.", June 1999.

Walker, G., 2002, "How to select a Tablet P.C.", Pen Computing Magazine, December 2002 Issue, http://www.pencomputing.com/frames/textblock_tpc_select.html

Links

Assistive Technology, Inc - Assistive Technology, Inc. provide innovative software and hardware solutions, such as the **Mercury and Gemini** A.A.C. devices, for people with special needs. <http://www.assistivetech.com/prod-index.htm>

Compaq/HP online store – detailed specifications and prices for Compaq and H.P. P.C.'s, <http://austore.compaq.com/>

Dell homepage, <http://www1.ap.dell.com/content/default.aspx?c=au&l=en&s=gen>

GEWA - speech aids, computer adaptations, telephone aids and remote controls adapted for different types of housing environments.
<http://www.gewa.se/english/download/loadfram.html>

Gus Communications – this company sell a variety of windows based speech products. They have packaged systems using the **Fujitsu Stylistic, Panasonic Toughbook** and their own **Communicator 35 & 25**. <http://www.gusinc.com/complete.html>

Panasonic Toughbooks homepage – this gives detailed specifications on the Toughbook range. It also explains the ruggedised features and the durability testing.
<http://www.panasonic.com.au/toughbook/>

Toshiba homepage, <http://www.toshiba.com.au/>

Words Plus – This gives information on the **Freedom 2000 Toughbook** A.A.C. devices.
<http://www.words-plus.com/>

Z.D.Net Australia – 5 Tablet P.C.s tested. This page reviews and compares the Acer, Toshiba, Fujitsu, Viewsonics and Compaq tablets.
<http://www.zdnet.com.au/reviews/computers/notebooks/story/0,2000023508,20269782-2,00.htm>

Zygo Industries – For information about the **Optimist** A.A.C. device. Zygo Australia specialises in electronic communication devices and technical aids for people with disabilities to assist with independence in daily tasks.
<http://www.zygo-usa.com/index.html>
<http://www.zygoaustralia.com.au/>

Appendix A Specifications – ‘Off-the-Shelf’ laptop/tablet based A.A.C. devices

	Mercury	Gemini	Optimist	Freedom 2000 Extreme Toughbook (based on toughbook 28)	Freedom 2000 Toughbook (based on toughbook 50)	Communicator 35
Producer	Assistive Technology Incorporated	Assistive Technology Incorporated	Zygo	Words+	Words +	Gus Communications
Processor	400 MHz Intel® Celeron®	G3	Pentium M.M.X. 166MHz	Intel Pentium III 800MHz	Intel Pentium IV 4GHz	Pentium III 600MHz
Operating system	Windows® X.P.	Mac OS 9.1	MS-Windows®98	Windows XP	Windows XP	Windows 98
Weight	2.95kg	3kg	2.5kg	4.6kg	4kg	4.1kg
Dimensions (w x h x d)	305 x 232 x 44 mm	345 x 292 x 46 mm	296 x 222 x 36 mm	300 x 292 x 95 mm	325 x 285 x 76 mm	331 x 293 x 47
Battery	Lithium Ion	Lithium Ion	Lithium Ion	Lithium Ion	Lithium Ion	Lithium Ion
Battery life	4hrs continuous	4hrs continuous	4hrs continuous	4.5hrs continuous	3hrs continuous	40mins (4hrs additional battery)
Drives	C.D.-ROM	C.D./D.V.D.-ROM	Floppy	C.D.R.O.M.	C.D./D.V.D.-ROM, floppy	Optional external C.D. ROM/floppy
Ports	• U.S.B. port • Switch(es) • Wheelchair/joystick port.	• U.S.B. port • Headphone jack • External speaker jack • Switch(es) • Wheelchair/joystick port. • Modem • Ethernet Port • FireWire Port	• Floppy disk drive connector • P.S./2 keyboard/mouse port • Serial port • U.S.B. port • External microphone and earphone jacks • I.R.D.A. Infrared port	• Infrared 4Mbps IrDA • Serial, D-sub 9 pin • Parallel, D-sub 25 pin • Keyboard/Mouse Mini DIN 6 pin • U.S.B. 4 pin • Port replicator, 80 pin (reinforced) • Headphones/speaker, mini-jack stereo • Microphone/line in	• Serial, D-sub 9 pin • Parallel, D-sub 25 pin • External video, D-sub 15 pin • External keyboard/mouse, Mini-Din 6 pin • 2 U.S.B. ports • Port replicator, dedicated 100 pin • Headphones/speaker • Microphone/line in Mini-jack Stereo • I.E.E.E. 1394 (Firewire) 4 pin	- PS/2 keyboard port - PS/2 Mouse port - D.C. input - 2 U.S.B. ports - I.R. (infrared) port - I.E.E.E. 1394 Port - Docking Station Port (160-Pin) - (Optional) RJ-45 x 1 for 10/100 Base-T Ethernet - (Optional) RJ-11 x 1 for 56K Fax Modem, P.C.I. interface - MIC-In Port - Ear Phone Out Port
Memory	256 MB RAM	160MB RAM	32 MB SDRAM, 4.1GB Hard disk	256MB SDRAM, 30GB Hard drive	256MB SDRAM (expand to 768MB), 40GB Hard drive	128MB (max 320MB)
Audio			Sound Blaster Pro compatible. Audio amplifier/speaker pack	ESS Allegro ES1988S audio controller	ESS ES 1988 Allegro P.C. Audio controller. Integrated stereo	-Built-in PCI 3D Audio controller -Full duplex support

	Mercury	Gemini	Optimist	Freedom 2000 Extreme Toughbook (based on toughbook 28)	Freedom 2000 Toughbook (based on toughbook 50)	Communicator 35
					speakers. Keyboard volume control	-Built-in stereo speakers
Durability				Full magnesium alloy case. Hard drive mounted in shock-absorbing gel and stainless steel case. Screen is spill and dust resistant	Magnesium-encased LCD panel. Fiberglass-reinforced lower case. Shock-mounted hard drive.	Shock: Operating : 15g, 11 ms, half sine wave Non-operating : 70g, Drop: 3 Feet to concrete surface.
Speech Output	Speaking Dynamically™ Pro and Boardmaker™	Speaking Dynamically Pro, MacinTalk Pro	Winspeak with DECTalk	Talking screen, E.Z.-Keys	Talking screen, E.Z.-Keys	Speaking Dynamically™ Pro and Boardmaker™
Speech Storage Capability	Record speech and sounds with the built-in microphone or 3 Microsoft voices	Record speech & sounds with U.S.B. microphone		Micro CommPac with Eloquence or DecTalk	Micro CommPac with Eloquence	
Access	Touchscreen, switch, joystick, speech, on-screen keyboard, external keyboard and mouse or alternative pointer	Switch input, touch-screen, keyboard, mouse, joystick, headmouse.	Switches, joystick, trackball or adapted mouse, an adaptive keyboard, voice recognition or the built-in touch screen	Keyboard, mouse, headmouse, switch access, joystick, Morse code, touchscreen	Keyboard, mouse, headmouse, switch access, joystick, Morse code, touchscreen	Wireless keyboard, mouse, touch-screen.
Environmental Control	Built-in, pre-programmed signals for most brands of T.V's, V.C.R's, etc included.		Option for built-in environmental control transmitter.			
Price * Where price has been converted from US to Australian dollars the conversion rate used was 1.356. The actual price in Australia is unknown so this is only an approximation.	AU\$15970 	US\$6495 *AU\$8807+shipping 	AU\$13900 	US\$9395 *AU\$12740+shipping 	US\$6395 *AU\$8672+shipping 	US\$6980 *AU\$9465+shipping 

Appendix B Specifications – Laptops

	Compaq Evo Notebook N620c	Panasonic Toughbook 28	Panasonic Toughbook 73	Panasonic Toughbook 48	DELL Inspiron 600M
Microprocessor	Intel Pentium IV M	Mobile Intel® Pentium® III	Mobile Intel® Pentium® III	Mobile Intel® Pentium® III	Mobile Intel® Pentium® III
Operating System	Microsoft Windows XP Professional or Microsoft Windows 2000.	Microsoft® Windows® NT 4.0 & 2000	Microsoft® Windows® 2000 and XP professional	Microsoft® Windows® 98SE standard	Microsoft® Windows® XP Professional or Home
Screen	14.1-inch color TFT SXGA+ with 1400 x 1050 resolution	13.3" 1024 x 768 (XGA) transmissive, anti-reflective, outdoor-viewable TFT Active Matrix Color LCD with or without Touchscreen or 12.1" 800 x 600 (SVGA) transfective, sunlight-readable TFT Active Matrix Color LCD with or without Touchscreen	13.3" 1024x768 (XGA) anti-reflective, sunlight-readable TFT Active Matrix Color LCD with Touchscreen	14.1" 1024 x 768 (XGA) TFT Active Matrix Color LCD	14.1" XGA display
Dimensions , weight (WxDxHmm) (kg)	31 x 307 x 250 2.1-2.45kg	302x275x65.5 4.1kg	297x254x43 2.5kg	307x259x25 3.39 kg	315x257x34 2.5kg
Battery life	Up to 6 hours or up to 10 hours with the optional MultiBay battery.	Up to 4.0 hours (with first battery), up to 10 hours (with second battery)	3.5 to 5.5 hours	Up to 3.5 hours	3-4hrs
System storage memory	256-MB 266-MHz SDRAM DDR SDRAM 30GB HDD DVD/CD-RW Combo Drive Optional floppy	256MB SDRAM expandable to 512MB 30GB HDD FDD Media bay Media Bay also accepts: • CD-ROM • DVD-ROM • SuperDisk drive • CD-RW • CD-RW+DVD Combo	256MB SDRAM expandable to 768MB 40GB HDD DVD ROM/CD-RW	128MB SDRAM expandable to 384 MB 20-30GB HDD Floppy disc Drive (FDD) DVD-Rom CD-ROM	256MB to 2GB DDR SDRAM • DVD/CD-RW Combo drive • 40GB removable HDD Optional: • DVD+RW/+R • Floppy
Access	• Keyboard, Touch pad • Point-stick • Mouse • 4 programmable Easy Access Buttons to provide one-touch access to programs/internet, ...	• Keyboard • Pressure sensitive touchpad • Pressure sensitive screen • Touch pad • Touch screen	• Keyboard • Pressure sensitive touchpad • Touch screen LCD	• Keyboard • Touch pad • Mouse	• Keyboard • Touch pad • Track stick • Mouse

	Compaq Evo Notebook N620c	Panasonic Toughbook 28	Panasonic Toughbook 73	Panasonic Toughbook 48	DELL Inspiron 600M
Ports	• MultiPort • P.C. Card 2 Type II/1 Type III • Enhanced Parallel EPP/ECP • Serial Port • S-video TV-out connector • External Monitor • PS/2 External • Keyboard/Pointing Device • Docking Connector • Headphone/Line-out • Microphone/Line- in • R.J.-11 (modem) • R.J.-45 (NIC) • Infrared Port • 2 U.S.B. Port (U.S.B. 2.0)	• U.S.B. • I.R. Port • Serial • Parallel • External keyboard/mouse • Port Replicator • Line in/line out mini jack • External video • Modem	• U.S.B. • Serial • Line in/line out jack • Port replicator socket • 10/100 RJ-45 LAN • Intel Pro/Wireless 2100 network connection • Modem • Headphones/speaker • External video	• 2xU.S.B. ports • Serial • Parallel • External video • Line in/line out mini-jack	• Serial • Parallel • 2xU.S.B. • Infrared • S-Video • Video 15pin monitor • Modem -R.J.-11 • Ethernet - R.J.-45 • Audio line out/line in • Microphone
Audio	Compaq <i>Premier Sound</i> ™ enhanced stereo audio system. Integrated 16-bit stereo audio	Integrated stereo speakers Keyboard volume controls	Integrated stereo speakers Keyboard volume controls	Integrated Stereo speakers Keyboard volume controls	Integrated Stereo speakers
Durability		• Magnesium alloy case • Moisture-resistant casing • Dust-resistant L.C.D., keyboard & touchpad • Sealed port and connector covers • H.D.D. in shock-absorbing gel • Flex connectors between major components	• Magnesium alloy case • Moisture and dust-resistant L.C.D., keyboard & touchpad • Sealed port and connector covers • H.D.D. in shock-absorbing gel • Flex connectors between major components	• Magnesium alloy case • Shock mounter H.D.D. • Flex connectors between major components	
Price (AU\$)	\$3240	\$6875	\$5899	\$5,000	\$2098
Image					

Appendix C Specifications – Tablets

	Acer Travel Mate C100	Fujitsu Stylistic LT P-600	Fujitsu Stylistic 3500	Fujitsu Stylistic ST4110	Compaq Tablet PC TC1000	Toshiba Portege 3500	Panasonic Toughbook 18
Durability	• Spill test • Drop test • Shock test • L.C.D. scratch test	• Internal magnesium frame • Additional case ribs • Special plastic and special resins • Optional harsh Environmental Case (HEC) • Shock mounted hard drive	• Internal magnesium frame • Additional case ribs • Special plastic and special resins • Optional HEC • Shock mounted hard drive	Magnesium alloy lower case provides significant protection over plastic casings found on other Tablet P.C's. In addition, the hard disk drive is shock-mounted to protect your data	• outer shell is a combination of magnesium alloy, engineering-grade polycarbonate polymer, and shock-resistant glass-to-bezel mounting.		• Designed using MIL-S.T.D.-810F test procedures • Full magnesium alloy case • Moisture- and dust-resistant L.C.D. keyboard and touchpad • Sealed port and connector covers • Shock-mounted H.D.D. • Rugged hinge • Vibration and drop-shock resistant design
Screen	10.4" TFT LCD Simultaneous LCD and CRT display	8.4-inch transfective SVGA TFT panel that you can use indoors and outdoors. (You can adjust the backlighting in eight levels.)	10.4-inch, 1,024-by-768 transmissive display, meant primarily for indoor viewing. (You can opt for a 10.4-inch reflective panel for outdoor viewing.)	10.4" XGA TFT, indoor viewable Electromagnetic (active) digitizer	10.4-inch color TFT XGA with 1024 x 768 resolution	12.1" Poly-silicon TFT Color LCD;	10.4" 1024 x 768 (XGA) transmissive, anti-reflective, outdoor-viewable TFT Active Matrix Color LCD with Digitizer
Microprocessor	Mobile Intel® Pentium® III	Intel Pentium® III	Intel Celeron	Mobile Intel® Pentium® III Processor 800MHz - M	1GHz Transmeta Crusoe 5800	1.33GHz Pentium III	Ultra Low Voltage Intel® Pentium® M Processor 900MHz
Sys tem storage memory	256MB SDRAM External U.S.B. CD-ROM 20GB HDD	128MB or 256MB SDRAM External FDD External CD-ROM 15GB HDD	64MB, 128MB or 256MB SDRAM External FDD External CD-ROM 15GB HDD	256MB onboard,; upgrade to 256MB or 512MB max to 768MB 30-60GB HDD	Standard 256 MB (133-MHz) SDRAM 30GB removable HDD	256-1024MB SDRAM 40GB HDD	256MB SDRAM (DDR) standard, expandable to 768MB 40GB HDD

	Acer Travel Mate C100	Fujitsu Stylistic LT P-600	Fujitsu Stylistic 3500	Fujitsu Stylistic ST4110	Compaq Tablet PC TC1000	Toshiba Portege 3500	Panasonic Toughbook 18
Audio	Audio system with built in speaker Built-in microphone	Sound Blaster® Built in speaker and microphone Microphone and headphone jacks	Sound Blaster® Microphone and headphone jacks	SigmaTel® STAC9767 with wavetable, 3D effect, and 3D positioning; Dolby® Headphone Utility to emulate realistic surround sound using conventional stereo headphones on DVD models; built-in microphone	Compaq <i>Premier Sound™</i> for enhanced stereo audio. Integrated 16-bit Sound Blaster Pro-compatible stereo audio 2 integrated speakers and microphone. External volume controls. Stereo Headphone-out	•Ali M1535 integrated software sound •16-bit stereo with built-in speaker and microphone •Direct 3D Sound; DirectSound and DirectMusic; Full Duplex and MIDI support •Sound Volume dial •Microphone port, headphone port	Integrated stereo speakers Keyboard volume controls
Ports	-2xU.S.B. ports -Ethernet port -Modem port -Video port -IR Port -Line in/line out jack -IEEE 1394 port	-U.S.B. -DC-in Jack -Microphone jack -Headphone jack -Modem jack -IrDA Wireless IR Keyboard port -Docking contacts	-U.S.B. -Type II PC card slot -RJ-11 -Microphone /Headphone jack -Modem jack -IrDA 1.1 -IR Keyboard port -Serial port -Floppy disc drive port -DC-in jack	2 U.S.B. 1.1 ports Infrared port (IrDA 1.1-compatible, 4 MBps) External monitor connector Modem (RJ-11) jack Ethernet (RJ-45) jack IEEE 1394 connector (firewire) Wireless IR keyboard receiver System interface connector headphone, microphone, and stereo line-in jacks.	-PC Card Slot -Compact Flash Slot -External Monitor -Stereo Headphone -Mono Headphone/Microphone -Microphone in -Modem -NIC -U.S.B. 2.0 Port -LED Status Indicators -AC Power	-RGB (monitor) port -2 Universal Serial Bus (U.S.B.) 2.0 ports -RJ-45 LAN port -RJ-11 modem port	Network Interface Card -100BASE-TX/10BASE-T, RJ45 External Video -D-sub 15 U.S.B. 2.0 (x2) -4 pin Headphones/Speaker -Mini-jack Stereo Microphone/Line In -Mini-jack Mono
Additional Ports		• Docking connections: • PS/2 mouse and keyboard ports • U.S.B. • Serial port • Ethernet jack • Parallel port • Video port	• Docking connections: • Type III PC card slot • PS/2 mouse and keyboard ports • U.S.B. • Serial port • Parallel port	Tablet Dock provides connectivity to: RJ-45 port for 10/100 Mb Ethernet, external monitor, 3 U.S.B. ports, IEEE 1394 port, Line-out, DC-input power, and either a modular DVD/CD-ROM or CD-ROM drive	Docking Station has four U.S.B. 2.0 ports, a VGA port		

	Acer Travel Mate C100	Fujitsu Stylistic LT P-600	Fujitsu Stylistic 3500	Fujitsu Stylistic ST4110	Compaq Tablet PC TC1000	Toshiba Portege 3500	Panasonic Toughbook 18
		• Floppy disc drive connector	• Floppy disc drive connector • Stereo line out jack	DVD/CD-RW or CD-ROM Drive			
OS	Microsoft® Windows® XP Tablet PC Edition	Microsoft® Windows® 98SE standard, Windows® 2000 pro	Microsoft® Windows® 98SE standard, Windows® 2000 pro, Windows NT Workstation 4.0	Microsoft® Windows® XP Tablet PC Edition	Microsoft. Windows. XP Tablet PC Edition	Microsoft. Windows. XP Tablet PC Edition	Microsoft® Windows® XP Tablet PC Edition
Access	• Fine touch keyboard • Touch pad • EMR stylus • Internet scroll key • Easy launch buttons • Embedded numeric keypad	Pen Docking station provides: Mouse Keyboard	Pen Touch screen Docking station provides: Mouse Keyboard	- Touchscreen pen - 4 user programmable application launch buttons Accessories: - Wireless keyboard - Wireless mouse - U.S.B. keyboard	Pen, Touchscreen The Compaq Tablet PC TC1000 comes with Command Control Buttons providing one-touch access.. 3 programmable pen activated buttons 3 programmable side buttons	-Keyboard -Toshiba Tablet Pen with hovering feature -4 Hardware Buttons: Windows Security Button, PageUp**, PageDown**, and Enter/Menu**	Touchscreen Keyboard Touchpad
Dimension(WxDxHmm) Weight(kg)	251 x 208 x 25.4 1.4 kg	244 x 160 x 28 1.2kg	280 x 215 x 27 1.46kg	301 x 220 x 22 1.45kg		295 x 234 X 33 1.9KG	272 x 216 x 48 2kg
Price (AU\$)	\$4500	\$6000	\$6000	\$3529	\$2575	\$3200	\$6050
Image							

Appendix D Things to consider when choosing a laptop for A.A.C.

Sandra Stewart & Sue van de Loo, June 1999

Define goals.

Define the student's needs and goals.

(for communication, computer access and environmental control).

i.e.: what are the specific communication tasks the student must perform in order to function in particular environments?

Consider the communication partners and the communication environments.

Communication environments may include social time, play time, car, shopping etc.

Consider whether a communication system based on a laptop computer will meet the student's communicative needs.

What are the student's communicative needs versus software access needs?

What proportion of time is required for each task?

Young students do not normally spend very much time using computer software each day. Their communicative needs are present throughout all of their waking hours even when they are using computer software.

Computing generally forms only a small part of student's learning in the first few years of schooling.

Early school learning is primarily communicative, social and activity based.

Consider whether the student will have access to a computer already within their home, school and other environments.

Why is an integrated system required?

What benefits does the integrated system offer over a dedicated communication system with wireless computer access?

If the integrated system stops working the student loses access to everything.

What will the backup plan be?

Powering the laptop.

How will the laptop be powered?

Can it run off the wheelchair battery?

How long will the wheelchair battery last with driving and communicative demands?

What happens when the wheelchair battery goes flat?

Does the laptop have a car charger socket (cigarette lighter) to connect the wheelchair battery to?

How reliable is it to charge the battery this way?

What cables are required? Will they get in the way?

If the laptop goes flat the student will not be able to access software or communicate.

Can the battery be hot swapped?

Can the user access AC power in the classroom without causing an OHS&W hazard?

Opening and closing the lid.

Can the student do this independently?
How will this impact on communication? eg. dependency, time, effort
Will the lid form a barrier to communication?
Will the lid form a barrier to wheelchair driving?
Is the lid durable enough for the environments it will be exposed to?
If you close the lid does the computer shutdown?

Turning the laptop on.

Where is the on/off switch?
Can the student turn the laptop on/off independently?
How will this impact on communication? eg. dependency, time, effort
Can it be made accessible?

Start-up time.

How long does the computer take to boot up?
This is time the student must wait before communicating.
How long does the communication program take to start up?
Can the communication program be placed in the start up menu?
Will the student be able to get into the communication program independently?
Does the computer have a resume feature?
How long does the resume feature take to return to the program?
Can the time before the device goes to sleep be adjusted so the user can communicate whenever they want?
If so, how will this affect the battery life? (adjust screen saver settings)

Switch Connection/ Joystick.

Does the computer have a serial port?
Does the software use the serial port?
Is a PS-2 mouse driver required?
Are 2 serial ports required?
What port is required for a joystick? Have allowances been made for this?
If one joystick is required what is involved in toggling between wheelchair driving and communication?
Will an E.C.U. be required?
What port will the E.C.U. use?

RAM.

What RAM is required to allow other software to be used while the communication software is minimised for ready access?
How will the speed of the communication software be affected by the other software?
What RAM is required to run the on screen keyboard?
What RAM is required to run the word processor, CD etc?
What RAM will be necessary for future use/growth/new programs etc?

Access to the computer software.

How will the student access the computer software?

If the student is using alternate access an on-screen keyboard may be required.

Is an on screen keyboard compatible with the communication program?

If so, which one?

How flexible is the on screen keyboard?

Will it allow the alphabet to be introduced gradually?

Can the layout be customised to suit the access technique and the particular program they are accessing?

Can symbols be used for preliterate students?

Can you launch the computer programs from the communication software?

Can you return from the computer program to the communication software?

Can the user load/unload CDs/floppy discs independently?

How is the software loaded?

Does the laptop have floppy and CD access?

Screen requirements.

Does the laptop have an active screen?

An active screen is required for facilitators, otherwise they need to stand directly behind the student while assisting them to learn their access technique and communication software.

Laptop screens are difficult to position optimally and can be fatiguing and/or lead to neck/eye strain for the student, especially as they get taller.

Can the student see the screen in various lighting conditions, including outside?

Volume.

What is the maximum volume of the laptop for the communication software?

Is this adequate for noisy environments such as the classroom, playground, shopping centres?

Is an external speaker required?

Which speakers are compatible?

How will the speaker be powered? Will this affect portability?

Where will the speakers be mounted?

Is auditory scanning available?

If so can synthesised prompts play through a private speaker?

Printer.

Is a printer required? If so, for what purposes?

Who will fund the printer?

What environments will the printer be required?

NB. It is likely the printer will not be easily portable

Can the user use the printer independently eg. Load paper, fix jams etc?

Reliability/history/compatibility.

What is the history, proven compatibility and reliability of the chosen software to be installed on the computer?

Will they perform the required functions to meet the student's needs?

Is any proposed E.C.U. compatible with the other software?

Can the software drive the E.C.U.? NB. Additional hardware may be required.

Other considerations.

What size screen, keyboard is required?

What windows operating system is required for the communication software and for the other programs?

Note: Win NT and now Win 2000 will be problematic for all disability/access software

Is a CD drive required? If so, consider a built in CD rather than a connectable one.

Environmental Issues.

How will the unit, cables and peripherals be protected from saliva, rain, drinks, dust, paint, sand etc?

What damage are these likely to cause a laptop?

If a switch skin (clear protector) is used over the screen itself what impact will this have on visual clarity for the user?

Who will fund these protective devices?

Mounting.

What positions/equipment is the student in throughout the day/night?

How will the laptop be mounted/positioned to allow access?

How much of the day/night will the student be able to access the laptop for communication?

Can a mounting plate be attached to the laptop?

Does the student require their wheelchair tray for other purposes eg. Reading books, interacting with peers, doing craft, mealtimes? Can the laptop be mounted out of the way?

Does the student need the tray off for activities such as group participation, sand play, gastrostomy feeds etc? Can the laptop be accessed without the tray on?

How easily can the laptop be removed (especially in emergency situations)?

How easily can the mount be removed?

What cables will run from the laptop eg to the joystick, to the wheelchair battery, to the speaker, to the CD drive/disk drive, to the printer?

How will these affect transfers?

How often is the student transferred for toileting, position changes, transport etc?

What will happen for emergency access/resuscitation?

How will the weight of the laptop and the mount affect wheelchair stability?

How will the laptop and mount be transported in the car/van etc?

Will the mounting system minimise vibrations in order to protect the hard drive?

Will the student require a new wheelchair and therefore a new mount within the near future?

Can the mount be transferred to a new wheelchair

ie: Will the mounting be flexible and adjustable or fixed?

Funding.

What is the main purpose of the laptop?

If it is for communication, and is funded for this purpose, the laptop can only be retained by the student as long as it is being used for communication.

Who will purchase the other software eg. On screen keyboard, educational software, leisure software?

What will happen to these other programs if the laptop is withdrawn?

Who will fund the wheelchair battery connection, extra batteries, speaker, printer, CD drive, input device, mounting system, repairs?

Does the laptop come with a carrybag? Is one required?

Does the software have free upgrades?

What is the projected lifespan of the laptop?

Who will provide recurrent/ongoing funding for maintenance, repairs and upgrades?

Who will provide funding for training to non C.C.A. staff and carers?

Training.

Who will train the student, carers, facilitators, educators to use the laptop?

In order to support communication they will all need to know a certain amount about the laptop care, maintenance and operation of hardware and software.

Will sufficient learning time be available to teach the student and facilitators how to use the computer as well as the communication software?

What will the cost of this extra learning time be in regard to curriculum time and communicative competence?

Insurance.

Whose responsibility is the insurance?

Consider that different components may have been purchased by different people?

What will happen if the laptop is damaged or stolen at school? Is this covered under the school's policy?

Maintenance/repairs/support.

If a problem arises how will it be determined whether it is a problem with the laptop, the software or a compatibility issue?

Who will take responsibility for this diagnosis?

Who will fund the repairs arising from different issues?

Who will pay for computer upgrades?

Sandra Stewart.

*Senior Speech Pathologist.
Technology Consultative Team.
Crippled Children's Association (SA).*

Sue van de Loo.

*Senior Occupational Therapist.
Technology Consultative Team.
Crippled Children's Association (SA).*

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